Lockheed Martin Corporation
1600 Tallevast Road, Sarasota, Fl 34243
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LOCKHEED MARTIN

Electronically Transmitted

October 26, 2017

Ms. Simone Core, P.E.
Remediation Engineer
Florida Department of Environmental Protection
Permitting and Waste Cleanup
13051 N. Telecom Parkway
Temple Terrace, FL 33637-0926

Re: 2017 Remedial Action Status Report
Lockheed Martin Tallevast Site
FDEP Site No. COM_169624/Project No. 238148
Tallevast, Manatee County, Florida

Dear Ms. Core:

Please find enclosed one copy of the 2017 Remedial Action Status Report (RASR) for the referenced site. Per your request, this RASR is being distributed to you in electronic form only. This RASR covers the period of performance from September 1, 2016 through August 31, 2017 and provides a comprehensive summary of system operation and maintenance for the groundwater treatment system. This report also summarizes other Site-related programs that include persulfate pilot study monitoring, groundwater level monitoring, effectiveness monitoring, private well monitoring, and wetlands monitoring. If you have any questions, please contact me at 240-687-1813, or paul.e.calligan@lmco.com.

Sincerely,

Paul E. Calligan, P.G.
Project Manager, Environmental Remediation
Lockheed Martin Corporation

cc: Ms. MaryEllen Fugate, SWFWMD (email)
Mr. Derek Matory, EPA (hard copy)
Mr. Randy Merchant, FDOH (CD)
Mr. Robert Brown, Manatee County (hard copy and CD)
Mr. Andre Rachmaninoff, Manatee County (hard copy and CD)
Mr. Tom Larkin, Manatee County, (CD)
Mr. Michael DiPinto, Manatee County (CD)
Mrs. Laura Ward (hard copy and CD)
Mrs. Wanda Washington (hard copy and CD)
Mr. Rob Powell, Ramboll (CD)
Mr. Kent Bontrager, SMAA (CD)

Lockheed Martin Corporation
Tallevast Site
Remedial Action Status Report
September 2016 through August 2017
Tallevast, Florida

Prepared for:

Lockheed Martin Corporation

Prepared by:

AECOM

October 26, 2017

FDEP Site No. 169624

FDEP Project No. 238148

Lewis J. Davies, P.E., C.B.C.
Project Director

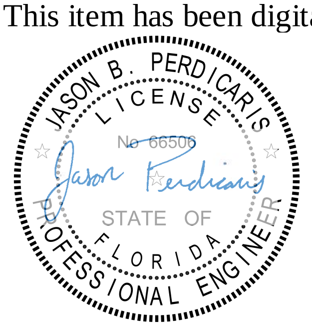
Michael D. McCoy, P.G.
Project Manager

CERTIFICATION

This Remedial Action Status Report for the Remedial Action Plan Addendum Groundwater Recovery and Treatment System at the Lockheed Martin Tallevast Site located at 1600 Tallevast Road, Sarasota, Florida covers the time period of September 1, 2016 through August 31, 2017. This report has been prepared for Lockheed Martin Corporation under the direction of a State of Florida Registered Professional Engineer. The work and professional opinions rendered in this report were developed in accordance with Section 471 Florida Statutes, the governing state and federal regulations, and commonly accepted protocols and procedures. If conditions are discovered that differ from those described, the undersigned should be notified.

This item has been digitally signed and sealed by: Perdicaris, Jason

Digitally signed by Perdicaris, Jason
DN: cn=Perdicaris, Jason, ou=USORL3
Reason: I have reviewed this document
Date: 2017.10.26 18:19:23 -04'00'



Jason Perdicaris, P.E.
Florida Professional Engineer
License No. 66506
Engineering Business No. 8115

Date: 10/26/2017

Printed copies of this document are not considered signed and sealed. The signature must be verified on the electronic document.

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Acronyms, Abbreviations, and Units of Measurement

µg/L	micrograms per liter
°C	degrees Celsius
ABC	American Beryllium Company
AECOM	AECOM Technical Services, Inc.
AF	Arcadia Formation
AOP	advanced oxidation process
COC	contaminant(s) of concern
1,1-DCA	1,1-dichloroethane
1,1-DCE	1,1-dichloroethene
cis-1,2-DCE	cis-1,2-dichloroethene
1,4-D	1,4-dioxane
DID	District Identification
F.A.C.	Florida Administrative Code
Facility	The "Facility" is defined as the property of approximately 5 acres at 1600 Tallevast Road
FDEP	Florida Department of Environmental Protection
FIT	flow indicator transmitter
ft	feet
GAC	granular activated carbon
GCTL	groundwater cleanup target level
GRTS	Groundwater Recovery and Treatment System
ID	isotope dilution
Lockheed Martin	Lockheed Martin Corporation
LPGAC	liquid phase granular activated carbon

LSAS	Lower Shallow Aquifer System
LTWLM	long term water level monitoring
MCUO	Manatee County Utility Operations
msl	mean sea level
MW	monitoring well
OMM	operations, maintenance, and monitoring
PCE	tetrachloroethene
PLC	programmable logic controller
POTW	Publicly Owned Treatment Works
RAO	remedial action objective
RAP	Remedial Action Plan
RAPA	Remedial Action Plan Addendum
RASR	Remedial Action Status Report
RO	reverse osmosis
RW	reference wetland
S&P	Salt & Pepper
SIM	selective ion monitoring
Site	The "Site" consists of both the Tallevast Facility and the surrounding area groundwater that is impacted by contaminants of concern
SOP	standard operating procedure
SU	standard units
SWFWMD	Southwest Florida Water Management District
TCE	trichloroethene
TDS	total dissolved solids
TestAmerica	TestAmerica Laboratories, Inc.
TPOC	Temporary Point of Compliance
TW	target wetland
USAS	Upper Surficial Aquifer System
USEPA	United States Environmental Protection Agency

VC	vinyl chloride
VOC	volatile organic compound
WMP	Wetlands Monitoring Plan
WUP	Water Use Permit

Section 1
INTRODUCTION

Lockheed Martin Corporation (Lockheed Martin) presents this annual *Remedial Action Status Report* (RASR) to the Florida Department of Environmental Protection (FDEP). This document provides a comprehensive summary of the remediation and monitoring activities for FDEP Site No. 169624 as described below.

1.1 GENERAL

This RASR describes operation, monitoring and maintenance activities for the *Remedial Action Plan Addendum* (RAPA; ARCADIS, 2009a) Groundwater Recovery and Treatment System (GRTS), at the Lockheed Martin Tallevast Site (also known as the Former American Beryllium Company [ABC] Site) (the Site) located in Tallevast, Manatee County, Florida. The Site consists of both the Facility (also referred to as the "on-Facility" portion of the Site – see Figure 1-1) and the surrounding area (referred to as the "off-Facility" portion of the Site) where groundwater is impacted by contaminants of concern (COC). The RAPA dated July 14, 2009 was approved by the FDEP on November 5, 2010. This RASR covers the reporting period from September 1, 2016 through August 31, 2017.

This report was prepared in accordance with and contains the applicable items required in Rule 62.780.700(12), Florida Administrative Code (F.A.C.) for a RASR. The activities, analyses, and results described in this report demonstrate fulfillment of Lockheed Martin commitments and achievement of FDEP requirements. The RASR also provides permit compliance status for Southwest Florida Water Management District (SWFWMD) Water Use Permit (WUP) No. 20 020198.000 and Manatee County Discharge Permit #IW-0025S. Manatee County Utility Operations (MCUO) will continue receiving annual reports concurrent with FDEP reporting requirements. Also included in this RASR are results of the biennial Persulfate Pilot Study Monitoring, the Wetlands Monitoring, and the Long Term Water Level Monitoring (LTWLM) programs.

1.2 OBJECTIVES

The GRTS Remedial Action Objectives (RAOs) provided in the RAPA are as follows:

- Reduce the potential for human exposure to COC in groundwater.
- Hydraulically control groundwater containing COC in concentrations greater than the groundwater cleanup target levels (GCTLs) as listed in Chapter 62-777, F.A.C.
- Actively extract and treat the groundwater plume until concentrations are below GCTLs.
- Reduce the potential for exposure to COC present in soil at the Facility.
- Minimize community and natural resource disturbance.

The RASR provides descriptions and results demonstrating achievement of the RAOs.

1.3 REPORT ORGANIZATION

This report is organized into seven sections as described below.

Section	Description
1 – Introduction	Presents the purpose and objectives of remedial actions and the organization of this report.
2 – Background	Summarizes the regulatory and physical settings, site hydrology, geology and hydrogeology, and history of Facility operations.
3 – Groundwater Recovery and Treatment System (GRTS) Description	Provides a summarized description of the GRTS.
4 – System Operation, Maintenance, and Monitoring (OMM) Activities	Describes OMM, LTWLM, Persulfate Pilot Study Monitoring, and Wetlands Monitoring activities.
5 – System Operation, Maintenance, and Monitoring Results	Describes the results from OMM, LTWLM, Wetlands Monitoring, and Persulfate Pilot Study Monitoring activities.
6 – Summary	Summarizes conclusions from data and analyses presented in this report along with recommendations for changes to system operations and/or monitoring.
7 – References	Lists the references used to support and prepare this report.

Section 2
BACKGROUND

This section of the RASR provides an overview of the Facility location, regulatory setting, Facility description, and historical operations. A more detailed description of the GRTS can be found in the first *Lockheed Martin Tallevast Site RASR* (AECOM Technical Services, Inc. [AECOM], 2014) submitted to the FDEP on October 28, 2014.

2.1 FACILITY LOCATION

The Facility is an approximate five-acre property located at 1600 Tallevast Road, between the cities of Sarasota and Bradenton, in southwestern Manatee County, Florida. Land use in the area is consists of single-family residential homes, churches, light commercial and industrial development, and heavy manufacturing. The location of the Facility is shown on Figure 1-1.

2.2 REGULATORY SETTING

The RAPA was developed in accordance with the Consent Order for the Site entered into by Lockheed Martin and FDEP. The File Number for the Consent Order is 04-1328 with an effective date of July 28, 2004, as amended by Consent Order No. 08-2254 with an effective date of October 13, 2008. The Consent Order requires Lockheed Martin to perform assessment and remediation activities at the Site.

Lockheed Martin submitted the RAPA to the FDEP on July 14, 2009. The FDEP issued a Remedial Action Plan (RAP) Approval Order on November 5, 2010. Construction of the full-scale groundwater remedy provided in the RAPA began in March 2011. A challenge to the RAP Approval Order was heard by an Administrative Law Judge, who recommended in an October 6, 2011 filing that FDEP issue a final order approving the RAPA. The final order from FDEP was received on January 4, 2012, and construction of the GRTS was completed April 2013. The startup of the GRTS occurred on November 18, 2013. The activities described within this RASR have been conducted in accordance with the Consent Order.

2.3 FACILITY DESCRIPTION

This section provides the physical setting of the Site and describes Site hydrologic, geologic, and hydrogeological conditions.

2.3.1 Physical Setting

The Facility is bounded by Tallevast Road to the north; 17th Street Court East to the east; a nine-hole golf course and driving range to the south; and an abandoned industrial property to the west, as shown on Figure 2-1. The treatment building is located in the north-central portion of the Facility property as shown on Figure 2-2. Two concrete driveways provide entry to the Facility from the north off of Tallevast Road. The treatment building is surrounded by a concrete parking area to the east, a concrete driveway to the south, and impermeable asphalt with a permeable artificial turf overlay to the north and to the west. A storm water retention pond is located west of the treatment building. A map showing Site monitoring well, extraction well, stilling well, private well and staff gauge locations is presented as Figure 2-3.

2.3.2 Site Hydrology

A number of small surface water bodies are located near the Facility. Manatee County completed improvements to stormwater control and drainage features along Tallevast Road during the reporting period. These improvements included replacement of existing drainage culvert pipes, installation of new stormwater structures and piping, and re-grading existing drainage swales and ditches. Several shallow swales convey surface runoff to streets and storm water channels. In addition, a number of wetlands are present near the Site according to the Florida Department of Transportation Florida Land Use, Cover, and Forms Classification System. Surface water on the western portion of the Facility flows west toward improved drainage features around the

Sarasota-Bradenton Airport, which drain into Sarasota Bay. Surface water on the easternmost portion of the Facility flows toward the Pearce Canal.

2.3.3 Site Geology and Hydrogeology

In January 1995, the SWFWMD published a report titled *ROMP TR-7 Oneco Monitor Well Site, Manatee County, Florida* (Southwest Florida Water Management District, 1995), which describes the drilling and testing of a well completed to a reported depth of 1,715 feet (ft) below ground surface at a location approximately 2.5 miles north of the Facility in southwestern Manatee County. The nomenclature used in that SWFWMD report to describe subsurface sediments is typically used to describe consolidated carbonate formations in the region and therefore is used for this Site. Local hydrogeologic units and water-bearing zones beneath the site are detailed in Figure 2-4.

2.4 FACILITY OPERATIONS

The following sections summarize the history of Facility operations and RAPA implementation.

2.4.1 History of Facility Operations

From 1962 until 1996, the Facility was owned by Loral Corporation and operated by ABC as an ultra-precision machine parts manufacturing plant in which metals were milled, lathed, and drilled into various components. Some of the components were finished by electroplating, anodizing, and ultrasonic cleaning. Chemicals used and wastes generated at the Facility included oils, fuels, solvents, acids, and metals. Lockheed Martin acquired ownership of the former ABC facility through its 1996 acquisition of Loral Corporation, the parent company of ABC. Historical plant operations were discontinued in late 1996. Lockheed Martin sold the property in 2000 and re-purchased it in June 2009 in order to prepare it for remedial actions.

2.4.2 History of RAPA System Implementation

Construction of the GRTS began in January of 2012, and Manatee County issued a Temporary Certificate of Occupancy on February 1, 2013. Construction reached substantial completion on

April 19, 2013, and Manatee County issued the final Certificate of Occupancy on August 21, 2013 when the Facility civil improvements were completed.

Startup and testing activities began in February 2013 and concluded on November 18, 2013, the date of official system startup. As-built Drawings, which included the soil control plan at the completion of Site civil activities, were submitted to the FDEP on November 14, 2013. The Site is currently in the operations, maintenance, and monitoring (OMM) phase of remedial activities.

Section 3

GROUNDWATER RECOVERY AND TREATMENT SYSTEM DESCRIPTION

A summarized process description of the Tallevast GRTS is presented in this section.

3.1 TREATMENT BUILDING SUMMARY

The GRTS equipment is housed inside a 14,200 square-foot reinforced concrete building. The Treatment System General Arrangement Plan, shown as Figure 3-1, provides the location of GRTS equipment in the process area. Updated Process and Instrumentation Diagrams depicting upgrades were provided to FDEP in the *Revised As-Built Drawing Submittal – Tallevast Treatment Facility* (AECOM, 2016a).

The process area contains the treatment equipment, chemical containment rooms, and the loading dock. Two chemical containment rooms located in the process area are designed for storage of the chemicals used in the treatment process. The treatment building is designed to contain more than the entire volume of water in the treatment plant stored in the piping, tanks and process equipment. The Facility is served by Florida Power and Light electric service and Manatee County water and sewer utilities. The treatment building also includes operator offices, restroom facilities, a break room, a sample preparation room, and a parts storage room.

3.2 EXTRACTION WELL AND PUMP SUMMARY

The GRTS includes 77 vertical groundwater extraction wells, four horizontal extraction wells, three infiltration galleries, and five injection wells. A submersible pump and pressure transducer are located in each extraction well. Wellhead piping with isolation valves is housed in a lockable well vault at each extraction well location. The GRTS extracts groundwater from 33 on-Facility vertical wells, 44 off-Facility vertical wells, and four off-Facility horizontal wells. The majority of the treated water is currently discharged to the publicly owned treatment works (POTW), but the GRTS is also able to discharge treated water to the infiltration galleries and injection wells. Groundwater is extracted from the upper four water-bearing zones underlying the Site to remove contaminated groundwater. The primary objectives of the GRTS are (a) to provide hydraulic containment and capture of the COC plume and (b) to ultimately achieve COC concentrations that are less than GCTLs in groundwater beneath the Site, two of the Site RAOs.

3.3 CONVEYANCE PIPING AND FIELD UTILITIES

Groundwater from horizontal and vertical extraction wells is transported in the underground conveyance piping network to the treatment plant. Each vault contains a flow meter, pressure transducer, sample port, check valve, Y strainer, and isolation ball valve. Piping from the individual off-Facility wells connects to main pipelines for conveyance of groundwater to the treatment building. On-Facility extraction wells are contained inside of pre-cast concrete vaults with the flow meters: check valves and sample ports are housed inside of the treatment building instead of at each well vault. On-Facility extraction wells are individually piped to the treatment building. Conveyance piping for the on-Facility and off-Facility extraction wells is combined once inside the treatment building. The off-Facility conveyance piping network contains main pipeline cleanouts that are contained inside pre-cast concrete manholes. These cleanouts are designed to provide an access point for cleaning of the main pipelines when necessary. Conveyance carrier piping is contained in secondary containment (i.e., containment piping, manhole structures, etc.) until it reaches the interior of the treatment building. Manifold piping inside of select cleanout manholes and extraction well vaults is constructed to provide leak detection in the capture and conveyance system using permanent dual containment termination fittings and the installation of capacitance sensors in select extraction well vaults capable of detecting water. Once the capacitance sensors detect water, the operator is alerted and the extraction well network is automatically disabled.

Five on-Facility injection wells are contained inside pre-cast concrete vaults. Each vault contains a level sensor, drop pipe, and air release valve. The flow rate to each well is controlled via flow control valves, and flow is totalized using a single flow meter inside the process area. Injection wells are supplied treated water from a single pump which feeds from the recharge tank inside the process area.

3.4 TREATMENT PLANT PROCESS OPERATION SUMMARY

Refer to Figure 3-2 for a process diagram. Extracted groundwater is pumped to the Treatment System where pre-treatment equipment is used to adjust the pH of the groundwater, oxidize metals, and remove solids using settling tanks, media filters and ultrafilters. Solids and metals removed are pumped to a solids thickening tank for further settling. The concentrated solids are dewatered using a filter press before being loaded into 55-gallon drums and transported as non-hazardous waste to a licensed and permitted landfill. Advanced oxidation process (AOP) units and liquid phase granular activated carbon (LPGAC) vessels are used to provide treatment of contaminants. After AOP treatment, remaining 1,1-dichloroethane (1,1-DCA) is removed using LPGAC. Water that has been treated through the settling tanks, filters, AOP units, and activated carbon processes meets the POTW discharge standards. Aside from discharge to the POTW, treated water can be used for the following: 1) backwash supply water for the media filters and LPGAC vessels; 2) further process treatment through softeners and reverse osmosis (RO) systems to meet GCTLs and Florida Surface Water Quality Criteria for application to the infiltration galleries or injection wells; and 3) non-potable process water used for equipment wash-down, Facility irrigation, and miscellaneous non-potable uses. The on-Facility injection wells are intended to recharge the Upper Surficial Aquifer System (USAS) on-Facility via a series of five passive injection wells to conduct focused flushing of areas with the highest historical COC concentrations. The three off-Facility infiltration galleries are used as needed to maintain established wetland hydroperiod water levels to minimize wetland health impacts due to drawdown effects of the groundwater extraction system.

A compressed air system operates the pneumatic systems, including double-diaphragm pneumatic pumps and the pneumatic valves. Compressed air is also used to assist in metals oxidation in the primary pretreatment tanks. Displaced air from each of the pre-AOP holding tanks, backwash surge tank, and solids thickening tank vent systems is routed to the vapor phase granular activated carbon (GAC) vessels located in the process area loading dock for passive treatment of volatile organic compounds (VOCs).

Various process instruments are used to monitor key process variables (primarily flow rate, water level, line pressures, pH and temperature). Redundant alarms, switches, and control logic are used to automate the GRTS and prevent system failures such as accidental overfilling of tanks. A programmable logic controller (PLC) provides control and communications between systems, equipment, and instrumentation. The treatment building includes an operations room where operators monitor and control the GRTS.

Section 4

SYSTEM OPERATION, MAINTENANCE, AND MONITORING ACTIVITIES

This section describes activities conducted as part of system OMM. The data and conclusions resulting from these activities are detailed in Sections 5 and 6 of this document.

4.1 SYSTEM OPERATION

The GRTS operated continuously from September 1, 2016, through August 31, 2017, with the exception of pre-planned downtime for required maintenance activities and a limited number of unplanned shutdowns. The extraction wells were in operation during the reporting period, with the exception of extraction well EW-5002 (refer to Section 5.4.1 below).

An OMM log describing key GRTS operations, maintenance activities and downtime events is presented in Table 1. Treatment plant shift daily logs document the key GRTS readings and are presented in Appendix A. System runtime is discussed in Section 5.1, and historical system runtime is presented in Table 2. Monthly extraction well volumes are presented in Table 3.

Startup of the on-Facility injection wells occurred October 4, 2016. Discharge to infiltration galleries RC-7001 and RC-7003 was initiated on July 5, 2017. Discharge to RC-7002 began on July 9, 2014 and continued throughout the reporting period. Additional details, to include volumes of water discharged, are provided in Section 5.2. The use of treated effluent to the Facility irrigation system used for the maintenance of landscaping was initiated April 17, 2017.

4.2 WATER TREATMENT PROCESS AND COMPLIANCE MONITORING

The following sections describe water treatment process sampling and laboratory analyses. Data that demonstrate RAPA and regulatory permit compliance are also provided. Water treatment and compliance sampling were conducted in accordance with FDEP Standard Operating Procedures (SOPs) FS 2000 *General Aqueous Sampling*, revision date March 1, 2014 (Florida Department of Environmental Protection, 2014a) and FC 1000 *Cleaning/Decontamination Procedures*, revision date March 1, 2014 (Florida Department of Environmental Protection, 2014b). Table 4 summarizes the monitoring schedule as originally specified in RAPA Table 12-1.

4.2.1 Compliance Sampling

Treatment System POTW effluent compliance samples were collected in accordance with the RAPA and the requirements of Manatee County Discharge Permit #IW-0025s. The Manatee County Discharge Permit, located in Appendix B, was renewed in late 2015 with an effective date of November 9, 2015. The current permit expires November 8, 2018. Compliance sampling dates and analytical results for effluent sampling completed are presented in Table 5. The analytical results of this sampling are described in Section 5.2. The calibration sheet from March 24, 2017, for discharge flow indicator transmitter (FIT) 500 is presented in Appendix C.

TestAmerica Laboratories, Inc. (TestAmerica) located in Tampa, Florida analyzed compliance samples using United States Environmental Protection Agency (USEPA) Method 8260B for VOCs and USEPA Method 8260C with heated purge and selective ion monitoring isotope dilution (SIM/ID) for 1,4-dioxane (1,4-D). Effluent samples were also analyzed for the 12 metals (aluminum, arsenic, beryllium, cadmium, chromium, copper, iron, lead, nickel, zinc, sodium, and molybdenum) specified in the MCUO Discharge Permit by USEPA Method 6010B. Temperature and pH are continuously monitored using treatment plant instrumentation.

4.2.2 GRTS Performance Monitoring Sampling

Performance samples were collected October 11, 2016, from the RO system effluent to monitor discharge to infiltration galleries and injection wells. TestAmerica in Tampa, Florida analyzed these samples using USEPA Method 8260B for VOCs and USEPA Method 8260C with heated purge, and SIM/ID for 1,4-D. Samples were also analyzed for the RO system effluent 10 metals (aluminum, arsenic, beryllium, cadmium, chromium, copper, lead, nickel, zinc, and sodium) by USEPA Method 6020A, total dissolved solids (TDS) by Standard Method 2540C, and for chloride and sulfate by USEPA Method 300.0, as specified in RAPA Table 10-3 (see Table 6), to confirm RO permeate met the lower of either GCTL or surface water quality criteria for discharge to infiltration galleries and adherence to GCTL for discharge to injection wells.

To monitor critical process performance parameters and carbon breakthrough, performance samples are collected at the combined plant influent, AOP feed, AOP effluent, and the primary and secondary carbon vessel discharge points. These samples were analyzed using USEPA Method 8260B for VOCs and USEPA Method 8260C with heated purge, and SIM/ID for 1,4-D. Refer to Table 7 – Analytical Results Process Monitoring and Table 8 – Analytical Results Combined Influent for results from this process sampling. Section 5.2 includes a discussion of the analytical results.

4.2.3 SWFWMD Water Use Permit Compliance

The SWFWMD issued General WUP No. 20 020198.000, which limits the volume of groundwater extracted at the Site, on November 18, 2011. The current permit, which is provided in Appendix D, expires on November 18, 2021 and is to be renewed one year prior to the date of expiration. As prescribed in the permit, Lockheed Martin is permitted to extract a total of 410,600 gallons daily from the network of extraction wells. Table 3 presents monthly extraction well volumes pumped. Table 9 summarizes groundwater volumes extracted, treated, and discharged. Section 5.1 summarizes the monthly influent flow totals plus the daily maximum and average flows. Permit special conditions require monthly reporting of meter readings at three District compliance points (District Identification numbers DID-95, DID-96, and DID-97). DID-95 and DID-97 correspond to the GRTS influent (FIT-100) and discharge to the POTW (FIT-

500), respectively. The discharge total for the infiltration galleries (RC-7001, RC-7002, and RC-7003), the injection wells (RC-6001, RC-6002, RC-6003, RC-6004, RC-6005), and treated effluent used for Facility irrigation is calculated (DID-95 minus DID-97) and submitted under DID-96. Summarized below, in Table 9a, are the dates that monthly WUP compliance point flow totals were submitted to the SWFWMD online e-Permitting website service portal. Appendix C contains flow meter calibration sheets for the extraction wells, combined influent, POTW effluent, combined injection well flow meters, and infiltration gallery flow meters.

Table 9a – Southwest Florida Water Management District (SWFWMD) E-Permitting Submittal Dates	
Month	**SWFWMD E-Permitting Submittal Date**
September 2016	October 3, 2016
October 2016	November 1, 2016
November 2016	December 5, 2016
December 2016	January 3, 2017
January 2017	February 1, 2017
February 2017	March 3, 2017
March 2017	April 5, 2017
April 2017	May 2, 2017
May 2017	June 1, 2017
June 2017	July 6, 2017
July 2017	August 8, 2017
August 2017	September 1, 2017

4.3 Water Level and Wetlands Monitoring

Groundwater level monitoring provides a means for confirming hydraulic capture of the COC plume and for ensuring adequate protection of groundwater supply resources. The following sections describe the water level gauging events performed in February 2017 and August 2017.

4.3.1 Semi-Annual Gauging Event

During the semi-annual groundwater gauging event, field personnel collected water levels from a total of 186 monitoring locations. These locations included monitoring wells, staff gauges, stilling wells, and piezometer wells, as identified in Table 10 and shown on Figure 2-3. The monitoring wells gauged during this event were opened and vented on February 13, 2017 and water levels were allowed to equilibrate for up to 24 hours. Field personnel gauged monitoring wells on February 14, 2017 while under GRTS pumping conditions.

4.3.2 Annual Effectiveness Monitoring Gauging Event

Field personnel opened monitoring wells on August 21, 2017 and water levels were allowed to vent and equilibrate for up to 24 hours. Monitoring wells were gauged on August 22, 2017 while under GRTS pumping conditions. Sampling personnel collected data during the annual event from 298 monitoring points, including monitoring wells, piezometers, staff gauges, and stilling wells, as identified in Table 11 and shown on Figure 2-3. Groundwater elevation and potentiometric contour maps were developed using data collected from the USAS, Lower Shallow Aquifer System (LSAS), Arcadia Formation (AF) Gravels, S&P Sands, and Lower AF Sands Aquifer. These data are presented in Figures 4-1 through 4-5, respectively. Capture boundaries shown on these figures are estimated using data from monitoring wells, stilling wells, and piezometers, and by applying professional judgment including consideration of information from extraction wells. The water level information and capture boundaries are discussed in Section 5.3.2 below.

4.3.3 Long Term Water Level Monitoring Program

The LTWLM program at the Site began in 2008 and has identified specific off-Site groundwater pumping stresses that were further investigated and evaluated using desktop and numerical modeling techniques and integrated into the conceptual site model. Another objective of the LTWLM is to characterize hydraulic interrelationships and gradients between geologic units on-Facility and off-Facility, to allow evaluation of potential regional groundwater trends, and to monitor the effects of groundwater extraction. The LTWLM program includes ongoing data collection and analysis, maintenance, and reporting of the LTWLM network of transducers located at the Site. The LTWLM events were conducted September 7 through 9, 2016, December 19 through 21, 2016, March 13 through 15, 2017, and June 5 through 7, 2017. The annual *Long-Term Water Level Monitoring Report* (Tetra Tech, Inc., 2017) is provided in Appendix E.

4.3.4 Wetlands Monitoring Program

In accordance with the July 2009 *Wetlands Monitoring Plan* (WMP; ARCADIS, 2009b) semi-annual wetland manual water-level monitoring events were conducted December 20 through 21, 2016 and June 7 through 8, 2017. Wetland telemetry monitoring systems continued to provide real-time collection of water levels at each of the reference wetlands (RWs) and target wetlands (TWs). The annual wetlands assessment was conducted June 7 through 9, 2017. Results of monitoring activities are provided in the *Wetlands Monitoring Report June 2016 through June 2017* (AECOM, 2017a: referenced herein as the Wetlands Monitoring Report) in Appendix F.

4.4 Groundwater Quality Monitoring

Groundwater quality monitoring was conducted in accordance with FDEP SOP *FS 2200 Groundwater Sampling*, revision date March 1, 2014 (FDEP, 2014c), and FC 1000 Cleaning/Decontamination Procedures (FDEP, 2014b). Completed groundwater sampling logs for the groundwater sampling events are included in Appendix G. Equipment used for field measurements were calibrated each morning before the start of purging and sampling, and a calibration check was conducted in the afternoon after activities were completed for the day.

Field personnel sampled monitoring and private wells as part of the effectiveness monitoring events and extraction wells as part of the GRTS performance monitoring program. The extraction wells and private wells were purged and sampled in accordance with FDEP SOP *FS 2200 Groundwater Sampling*, (2014c).

Groundwater samples were placed into insulated coolers and maintained at temperatures between 2 and 6 degrees Celsius (°C), (4°C±2°C). The coolers were sealed and the contained samples were delivered to TestAmerica for laboratory analysis. The coolers and samples were delivered to the laboratory under chain-of-custody procedures found in the USEPA's *Quality Assurance Handbook Volume II*, Section 8 (Environmental Protection Agency, 2008). Laboratory analytical reports and associated chain-of-custody forms are included in Appendix H. Data Validation Reports are presented in Appendix I. There were no laboratory analytical quality control issues that adversely affected data usability, as documented in the Data Validation Reports.

The groundwater purged during monitoring well sampling was stored in containers within secondary containment. Purged water was later manually transferred to the GRTS for treatment. The following sections provide more detail on the performance and effectiveness sampling events.

4.4.1 Semi-Annual Extraction Well Monitoring

Field personnel conducted groundwater sampling at 77 vertical extraction wells and four horizontal extraction wells(Table 12) on February 15 through 16, 2017 and August 9 through 10, 2017. Groundwater pumped from 30 on-Facility extraction wells was collected from the sample ports located on each dedicated line inside the treatment building. Groundwater samples from three of the on-Facility extraction wells, 44 of the off-Facility vertical extraction wells and the four off-Facility horizontal extraction wells were collected utilizing dedicated sample ports located inside their respective well vaults. TestAmerica analyzed the samples using USEPA Method 8260B for VOCs and USEPA Method 8260C SIM/ID with heated purge for 1,4-D. Section 5.4.1 includes a discussion of the analytical results provided in Table 12.

4.4.2 Semi-Annual Effectiveness Monitoring

Field personnel conducted groundwater sampling at 57 monitoring wells (Table 13) on February 17 and February 20 through 24, 2017. Monitoring well MW-101 was added to the semi-annual effectiveness monitoring schedule, as discussed in the Response to Comments 2016 Remedial Action Status Report (AECOM, 2017b). FDEP requested that monitoring well MW-101 be sampled semi-annually until a downward trend is observed with at least a 95% confidence factor using the *Mann-Kendall* statistical method (Mann-Kendall, 2003). TestAmerica analyzed the samples using USEPA Method 8260B for VOCs and USEPA Method 8260C SIM/ID with heated purge for 1,4-D. Section 5.4.2 includes a description of the analytical results provided in Table 14.

4.4.3 Biennial Persulfate Compliance Monitoring

As recommended in the FDEP-approved 2016 RASR (AECOM, 2016b), the frequency for persulfate compliance monitoring was decreased to biennial following the August 2016 sampling event. Monitoring wells and/or parameters have been eliminated from persulfate compliance monitoring as concentrations have decreased below baseline or GCTLs for two or more consecutive events. In order to confirm the results from the August 2016 sampling event, monitoring well MW-39 was sampled in February 2017 for USEPA Method SM2540C for TDS and USEPA Method 6010B for Aluminum. Section 5.4.3 includes a discussion of the analytical results provided in Table 15. The next persulfate compliance monitoring event will take place in August 2018.

4.4.4 Annual Effectiveness and Private Well Monitoring

As part of the annual effectiveness monitoring, on August 8, 2017, total depths were measured in the accessible monitoring wells in the annual sampling program. These measurements are used to determine if monitoring wells require redevelopment to ensure continued function. The monitoring well network did not require redevelopment to address siltation during this reporting period.

Annual effectiveness sampling was conducted at 148 monitoring wells, three private wells, and six piezometers between August 9 and August 31, 2017, in accordance with the RAPA and detailed in Table 13. TestAmerica analyzed the samples using USEPA Method 8260B for VOCs and USEPA Method 8260C SIM/ID with heated purge for 1,4-D. Section 5.4.4 includes a discussion of the analytical results of this sampling. The analytical data from the August 2017 annual sampling event are summarized in Table 14. The analytical results for sampling from the private monitoring wells are summarized in Table 16.

Section 5

SYSTEM OPERATION, MAINTENANCE, AND MONITORING RESULTS

This section provides results from system operation, treatment and compliance, water level, effectiveness and persulfate, and wetlands monitoring. The section also includes a summary of waste management activities.

5.1 SYSTEM OPERATION

The total volume of groundwater pumped from the extraction system for the reporting period was approximately 73,556,700 gallons, resulting in a total of 299,673,200 gallons of groundwater extracted and treated since initial system startup in November 2013. A monthly summary of groundwater volumes that were extracted, treated and discharged is presented in Table 9. The GRTS was operational for 95.3% of the reporting period. The GRTS was able to process groundwater for 8,346.7 hours, with 379.5 hours of planned downtime and 13.5 hours of unplanned downtime. GRTS runtime is presented in Table 2.

The summary table provided below (Table 16a) presents monthly influent flow totals, plus the daily maximum and average flows, as recorded automatically by the PLC and archived in the reporting software database. The flow rates during the reporting period were in compliance with the WUP pumping volume allowance of 410,600 gallons daily (annual average) from the extraction network.

Table 16a – SWFWMD Influent Flow Totals			
SWFWMD - District Identifications (DID)	**DID 95**	**DID 95**	**DID 95**
Month	**Maximum Daily Influent Flow in Gallons**	**Average Daily Influent Flow in Gallons**	**Monthly Total Influent Flow in Gallons**
September 2016	242,900	190,000	5,699,400
October 2016	237,300	202,100	6,265,700
November 2016	242.200	221,100	6,634,500
December 2016	235,300	199,600	6,012,100
January 2017	234,000	186,100	5,770,300
February 2017	228,300	213,600	5,982,900
March 2017	234,400	219,800	6,812,900
April 2017	225,400	217,800	6,534,400
May 2017	215,400	183,800	5,697,100
June 2017	244,500	200,800	6,023,000
July 2017	253,300	197,900	6,134,800
August 2017	263,400	193,200	5,989,600

Table 3 presents monthly flow volumes for individual extraction wells, as recorded automatically by the PLC. Table 9 presents the reporting period and cumulative groundwater volumes extracted, treated, and discharged, as recorded automatically by the PLC. Facility personnel continue to operate and maintain the GRTS 24 hours per day, 7 days per week, to keep the system operating effectively and safely.

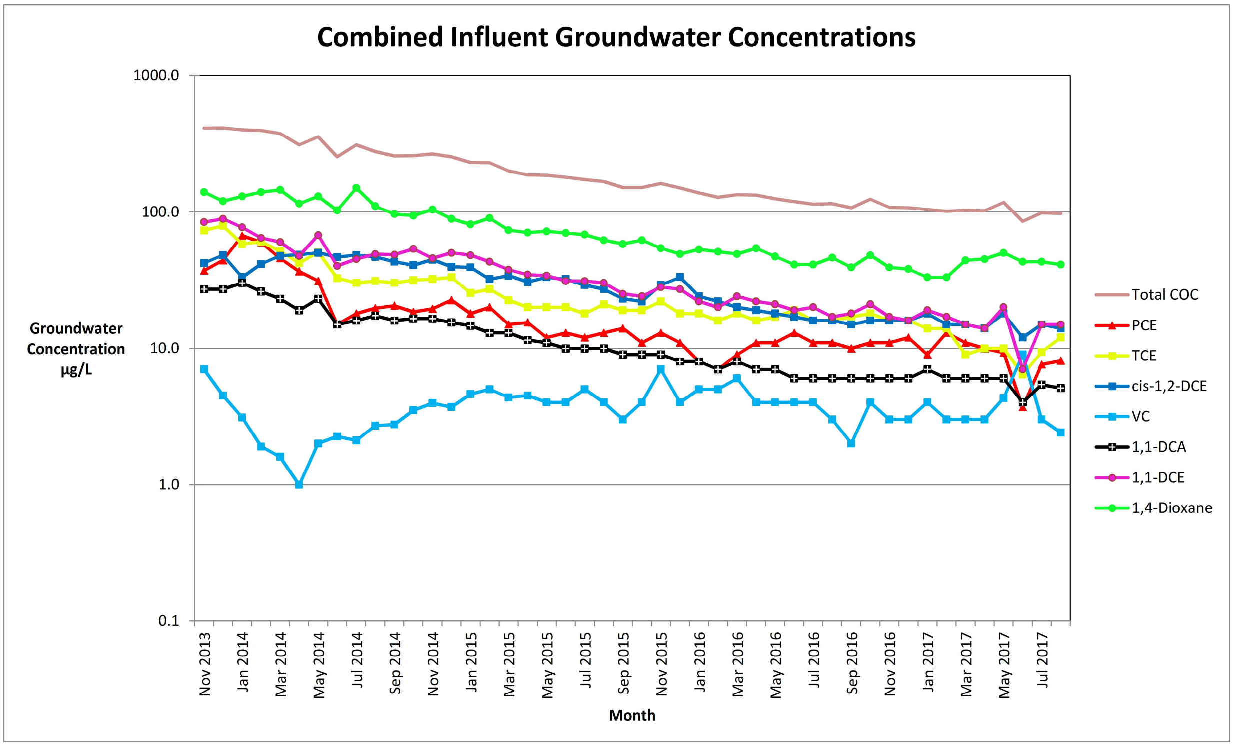
5.2 TREATMENT PROCESS AND COMPLIANCE MONITORING RESULTS

System process monitoring samples collected upstream and downstream of the AOP units and after the primary GAC and secondary GAC vessels demonstrate that the AOP and GAC process units are effectively treating groundwater to meet limits set forth in the Manatee County Discharge Permit and RAPA Table 10-3 (see Table 6). The monthly average GRTS combined influent COC concentrations are presented in Table 16b below, in micrograms per Liter (µg/L).

Table 16b – Averaged Monthly Plant Influent Total Contaminant of Concern (COC) Concentration	
Month	**Influent Total COC Average Concentrations (micrograms per liter [µg/L])**
September 2016	107
October 2016	123
November 2016	108
December 2016	105
January 2017	105
February 2017	100
March 2017	102
April 2017	103
May 2017	117
June 2017	77
July 2017	97
August 2017	97

The historical combined influent groundwater concentrations of individual COC concentrations are presented in Figure 5 below.

Figure 5 - Combined Influent Groundwater Concentrations



Both the individual and total COC concentrations have maintained a downward trend since the start of RAP operation; the exception is the concentration of vinyl chloride (VC), which has remained fairly consistent at low values since an initial drop in March 2014 and subsequent rebound. This observation is to be expected as VC is generated through the conversion of the higher order chlorinated compounds associated with TCE that can be degraded to ethene during anaerobic processes. VC may also be reduced aerobically. In the current scenario, where the concentration of VC is remaining stable, it appears that the rate of generation is relatively equal the rate of degradation and/or removal by the GRTS system. System combined influent samples were collected approximately twice per month as part of process monitoring. Samples were collected quarterly from the POTW effluent in accordance with the RAPA. To verify carbon breakthrough and media replacement schedules, process samples were collected upstream and downstream of the AOP units and at the primary and secondary carbon vessel discharge sample ports. Table 7 provides the GRTS process monitoring analytical results. These process sampling results also allow operators to track the effectiveness of the AOP in removing COC.

The permit requirements prescribed in the Manatee County Discharge Permit #IW-0025S were met. Refer to Appendix B for a copy of the Discharge Permit. Appendix B also includes the required Manatee County Industrial Pretreatment Program Certification Statement. There were no laboratory analytical quality control issues that adversely affected data usability, as documented in the Data Validation Reports. Analytical results for the treated effluent samples indicate that COC and metals concentrations in the treated effluent were below limits set forth in the Discharge Permit. Treatment efficiencies for VOCs and 1,4-D removal were 100% and 100%, respectively, averaged over the reporting period.

Presented below (Table 16c) are the Discharge Permit limits and recorded values for pH, temperature, and daily discharge flow.

Table 16c - Manatee County Discharge Permit Compliance Limits		
Monitored Parameter	**Discharge Permit Limits**	**Publicly Owned Treatment Works (POTW) Discharge Recorded Values**
pH Range	5 to 11.5 standard units (SU)	5.5 to 9.54 SU
Maximum Temperature	104 Degrees Fahrenheit	102.5 Degrees Fahrenheit
Maximum Daily POTW Effluent Flow	432,000 Gallons	239,600 Gallons
Average Daily POTW Effluent Flow	Report Only	190,800 Gallons

Presented below (Table 16d) are the monthly pH range and maximum recorded discharge temperatures that demonstrate compliance with the Discharge Permit.

Table 16d - Manatee County Discharge Permit Compliance			
Reporting Period	**Minimum POTW Discharge pH**	**Maximum POTW Discharge pH**	**Maximum POTW Discharge Temp (º Fahrenheit)**
September 2016	6.2	7.8	102.1
October 2016	6.0	7.8	101.0
November 2016	6.0	7.4	98.4

Table 16d - Manatee County Discharge Permit Compliance – Continued			
Reporting Period	**Minimum POTW Discharge pH**	**Maximum POTW Discharge pH**	**Maximum POTW Discharge Temp (º Fahrenheit)**
December 2016	6.3	7.8	100.3
January 2017	6.25	7.57	97.7
February 2017	6.23	7.45	97.4
March 2017	6.03	8.93	97.6
April 2017	6.35	7.63	96.8
May 2017	6.25	7.43	96.7
June 2017	6.15	7.44	99
July 2017	6.13	9.21	99.5
August 2017	5.52	9.54	102.5

The total volume of treated groundwater discharged to the POTW is recorded automatically by the PLC. These data, including maximum and average daily flows and water reuse conveyed to the infiltration galleries, injection wells, and the Facility irrigation system, are archived in the reporting software database and are presented below (Table 16e).

Table 16e – SWFWMD Effluent Flow Totals				
SWFWMD DID	**DID 97**	**DID 97**	**DID 97**	**DID 96***
Month	**Maximum Daily POTW Effluent Flow in Gallons**	**Average Daily POTW Effluent Flow in Gallons**	**Monthly Total POTW Effluent Flow in Gallons**	**Monthly Total Water Reuse in Gallons**
September 2016	236,400	182,900	5,486,000	213,400
October 2016	239,600	190,800	5,913,600	352,100
November 2016	208,200	188,600	5,657,800	976,700
December 2016	202,400	169,700	4,921,900	1,090,200
January 2017	204,000	154,100	4,776,900	993,400
February 2017	196,500	177,900	4,980,500	1,002,400
March 2017	203,100	178,500	5,532,200	1,280,700

Table 16e – SWFWMD Effluent Flow Totals – Continued				
SWFWMD DID	**DID 97**	**DID 97**	**DID 97**	**DID 96***
Month	**Maximum Daily POTW Effluent Flow in Gallons**	**Average Daily POTW Effluent Flow in Gallons**	**Monthly Total POTW Effluent Flow in Gallons**	**Monthly Total Water Reuse in Gallons**
April 2017	196,900	166,400	4,990,800	1,543,600
May 2017	159,000	129,500	4,013,800	1,683,300
June 2017	212,900	169,300	5,077,500	945,500
July 2017	219,000	162,800	5,048,300	1,086,500
August 2017	237,000	164,900	5,111,300	878,300

*Water reuse calculated using Plant influent total flow minus POTW effluent total flow

Table 9 provides additional information on volumes of groundwater extracted, treated and discharged via the POTW or through reuse/injection. The difference between the recorded values of the combined influent and the POTW effluent flow totals is due primarily to discharge to the three infiltration galleries, on-Facility injection wells, and on-Facility irrigation usage of treated effluent. However, potable water used for general treatment plant cleaning, filter press cleaning, and carbon change-out also contributes to the difference in recorded flow totals. Potable water used for these activities flows to the plant sump and is treated by the GRTS and subsequently discharged. This additional water volume is reflected in the POTW effluent flow total, but not in the combined influent flow total, because the potable water collected in the plant sump is not routed through the combined influent flow meter (FIT-100).

Samples collected from the RO system effluent confirmed that discharge to infiltration galleries and injection wells met both the GCTL and surface water quality criteria, as specified in RAPA Table 10-3 and shown on Table 6. Discharge of RO system effluent to RC-7002, located adjacent to TW-6 on the agricultural area to the east-southeast of the Facility, began on July 9, 2014 and continued throughout the reporting period. Discharge to recharge galleries RC-7001 and RC-7003 was initiated on July 5, 2017 and continued to the end of the reporting period. As shown on Table 9, a total of 10,448,000 gallons of RO system effluent was discharged to the three recharge galleries during the reporting period. Approximately 1,374,641 gallons of RO treated water was discharged to on-Facility injection wells RC-6001 through RC-6005 during the reporting period. The amount of treated water discharged to the recharge galleries and on-Facility injection wells totaled 16% during the reporting period. In addition, approximately 144,600 gallons (2%) of RO treated water was utilized for irrigation of on-Facility green areas during the reporting period.

5.3 GROUNDWATER LEVEL MONITORING RESULTS

The results of groundwater level monitoring are presented in Table 10. Groundwater elevation contour maps for the USAS, and potentiometric contour maps for the LSAS, AF Gravels, S&P Sands, and Lower AF Sands, based on the annual water level event, are provided as Figures 4-1 through 4-5, respectively.

Groundwater elevation data from some monitoring wells could not be contoured. Typically, this is due to monitoring wells of combined hydrogeologic units being presented on a single figure. Data plotted on the figure but not used in contouring are noted on the maps by an asterisk (*). Groundwater elevations measured at extraction wells were also not used in contouring; however, based on professional judgment, the localized effects of extraction wells and infiltration galleries were considered when contouring. Vertical hydraulic gradients in 2017 were calculated for each unit and were generally consistent with the August 2016 data. Gradients between vertically adjacent units were estimated by dividing the difference in the groundwater elevations between the two units by the distance between the bottoms of the screens for the wells in each of the units (Section 5.3.1).

5.3.1 Semi-Annual Gauging Event

During the semi-annual gauging event the vertical and horizontal extraction wells were operating with the exception of EW-5002, as discussed in Section 4.1. Additionally, EW-3001, EW-3003, EW-3004, and EW-3006 were not pumping during the gauging event because localized drawdown in these extraction wells exceeded control set points which allow pumps to resume pumping. The results of the semi-annual gauging event are presented in Table 10.

5.3.2 Annual Gauging Event

During the annual gauging event all of the vertical and horizontal extraction wells, with the exception of EW-5002, were operational. However EW-3004 and EW-3005 were not pumping during the gauging event due to normal cycling, when drawdown exceeds operational set points. The results of the August 2017 gauging event are presented in Table 10 and on Figures 4-1 through 4-5. Capture zones were approximated based on potentiometric contours and professional judgment. The similarity of the capture zones and water levels to prior years helps illustrate the consistent containment of the COC plume. In general, vertical gradients were downward from the USAS and LSAS toward the AF Gravels and upward from the Lower AF and S&P Sands toward the AF Gravels which is consistent with the design of the GRTS.

Elevation data from August 2016 and August 2017 and vertical gradient information are provided in Table 16f, below.

Table 16f – 2017 Average Water Elevations and Aquifer Vertical Gradients

Aquifer Zone	Average Water Elevation 2017 (ft above msl)	Average Water Elevation 2016 (ft above msl)	Change in Water Elevation from 2016	Average Vertical Gradient (ft/foot)
USAS	21.98	20.84	1.14	-0.90
LSAS	10.62	10.55	0.07	-0.13
AF Gravels	4.16	5.00	-0.84	+0.12
S&P Sands	7.54	8.30	-0.76	+0.03
Lower AF	12.07	13.82	-1.75	+0.06

msl=mean sea level
ft/foot = feet per foot
Negative number indicates downward vertical gradient
Positive number indicates upward vertical gradient

5.3.3 Long Term Water Level Monitoring

The long-term water level monitoring program provided detailed tracking of the hydraulic and hydrologic relationships within and between water-bearing zones over time. In general, the long-term water level data confirmed the assessment presented in Section 5.3.2, above. In addition, the continuous monitoring of wells near the edges of the Site provided information on the extent of GRTS effects for each water-bearing zone, which demonstrates that RAOs are being met.

5.4 GROUNDWATER QUALITY MONITORING RESULTS

Groundwater COC at the Site include 1,4-D; tetrachloroethene (PCE); trichloroethene (TCE); cis-1,2-dichloroethene (cis-1,2-DCE); 1,1-dichloroethene (1,1-DCE), 1,1-DCA; and VC and the applicable FDEP cleanup criteria are listed below.

COC	Groundwater Cleanup Target Level (GCTL) (µg/L) (62-777 F.A.C.)
1,4-D	3.2
TCE	3
PCE	3
cis-1,2-DCE	70
1,1-DCE	7
1,1-DCA	70
VC	1

5.4.1 Extraction Well Monitoring

Groundwater quality data for vertical and horizontal extraction wells are provided in Table 12. The results from the August 2017 sampling event indicated that COC concentrations in the USAS extraction wells have been generally declining since November 2013. Generally stable to decreasing COC concentrations in the LSAS were observed from November 2013 to August 2017. In the AF Gravels, laboratory analytical data indicated generally decreasing COC concentrations since November 2013. Two extraction wells are screened in the S&P Sands (EW-5001 and EW-5002). The results from the August 2017 sampling event indicated that COC concentrations in the S&P Sands extraction wells have generally increased since 2013 but have been generally stable to decreasing since February 2016. As discussed in Section 4.1 above and in the Response to Comments 2016 Remedial Action Status Report (AECOM, 2017b), Lockheed Martin evaluated the groundwater data and made the determination to keep extraction well EW-5002 off given the stable to decreasing COC trends observed at that well since the August 2016 extraction well sampling event and the extensive capture present in the Salt & Pepper (S&P) Sands. Note that extraction well EW-5002 is operated periodically to maintain well function and for groundwater sampling events. As evident by the results discussed above, the GRTS actively extracted and treated the groundwater COC plume during the previous reporting period.

5.4.2 Semi-Annual Effectiveness Monitoring

The results from semi-annual groundwater sampling are presented in Table 14. This table also includes historical data dating back to 2009. Further discussion of COC concentrations that includes consideration of the semi-annual groundwater sampling data is presented in Section 5.4.4.

5.4.3 Biennial Persulfate Compliance Monitoring

Field personnel sampled monitoring well MW-39 in February 2017 to confirm the results from the previous sampling event. Groundwater samples from monitoring well MW-39 were collected and analyzed for the persulfate pilot study parameters, as described in Section 4.4.3. Analytical results indicated that the concentration of aluminum and TDS were below GCTLs for the second consecutive event. The results from sampling are presented in Table 15. The next scheduled biennial event is for August 2018.

5.4.4 Monitoring Well and Private Well Annual Effectiveness Monitoring

Groundwater monitoring events are conducted on an annual basis in order to monitor current COC concentrations and provide a basis for comparison of the progress of ongoing active remediation occurring at the Site. The results of the annual effectiveness monitoring event at site monitoring wells and private wells are provided in Table 14. Figures 5-1 through 5-39 present 1,4-D, TCE, PCE, cis-1,2-DCE, 1,1-DCE, 1,1-DCA, and VC concentrations and interpreted isoconcentration lines in the USAS, LSAS, AF Gravels, S&P Sands, and Lower AF Sands. Observed historical variations in concentration and plume morphology in the various aquifers from August 2016 and August 2017 are discussed in Sections 5.4.4.1 through 5.4.4.5 below.

The following information is provided to aid the discussion of the annual sampling results:

- On November 8, 2016, MW-20 was abandoned in accordance with the FDEP *Monitoring Well Design and Construction Guidance Manual* (Florida Department of Environmental Protection, 2008) due to damage caused by others during a period of railway maintenance and construction activities. Replacement well MW-20R was installed on November 8, 2017. Boring Logs and Well Installation and Development Logs are provided in Appendix J.

- Analytical results indicated an overall decline in average COC concentrations in the monitoring wells in the USAS, LSAS, AF Gravels, and S&P Sands since August 2016, indicating continued reduction of in-situ COC mass. Appendix K includes VOC concentration versus time charts for a group of selected monitoring wells. The horizontal distributions of COC within aquifer zones in August 2017 were generally consistent with the distributions during August 2016.

- Average concentrations for each COC for the USAS, LSAS, AF Gravels and S&P Sands, using the laboratory analytical data from the August 2016 and August 2017 sampling events, are summarized in Tables 16g, 16h, 16i, and 16j in the sections below. To avoid skewing results due to varying detection limits, and in order to ease calculations in the tables, non-detect concentrations were set to zero.

5.4.4.1 COC Distribution in the USAS

The distributions of 1,4-D, TCE, PCE, cis-1,2-DCE, 1,1-DCE, 1,1-DCA, and VC in the monitoring wells and private wells within the USAS are shown in Figures 5-1 through 5-7, respectively. Average concentrations for each COC using the laboratory analytical data from the August 2016 and August 2017 sampling events are summarized below in Table 16g.

Table 16g - Average COC Concentrations in the USAS in 2016 and 2017

COC	Concentration (August 2016) (µg/L)	Concentration (August 2017) (µg/L)	Percent Change (USAS)
1,4-D	5.4	5.8	6.6
TCE	3.1	2.6	-16.6

Table 16g - Average COC Concentrations in the USAS in 2016 and 2017			
COC	**Concentration (August 2016) (µg/L)**	**Concentration (August 2017) (µg/L)**	**Percent Change (USAS)**
PCE	11.0	4.6	-58.0
cis-1,2-DCE	0.5	0.5	0
1,1-DCE	1.6	1.6	0
1,1-DCA	1.2	1.2	0
VC	0.0	0.0	0

The composite COC distribution in the USAS is presented in Figure 5-8, along with the estimated USAS capture zone. The area of COC concentrations exceeding GCTLs in the USAS identified in August 2017 was 58 acres compared to 66 acres in August 2016. While average COC concentrations showed an overall decrease from the 2016 sampling event, the average concentration of 1,4-D slightly increased. The slight increase in average 1,4-D concentrations was reflected in increases in 1,4-D concentration being observed primarily at monitoring wells MW-27, MW-28, MW-29, and MW-75, where increases ranged between 4.6 µg/L and 16 µg/L. Appendix K includes VOC concentration versus time charts for a group of selected USAS monitoring wells (MW-27, MW-35, MW-67, and MW-254 [MW-BT-1]).

5.4.4.2 COC Distribution in the LSAS

The distributions of 1,4-D, TCE, PCE, cis-1,2-DCE, 1,1-DCE, 1,1-DCA, and VC concentrations in the monitoring wells and private wells within the in the LSAS are shown on Figures 5-9 through 5-15, respectively.

Average concentrations for each COC using the laboratory analytical data from the August 2016 and August 2017 sampling events are summarized below in Table 16h. Average concentrations for individual COC decreased, except for average cis-1,2-DCE concentration, which increased. Analytical data indicated that biotic or abiotic processes appear to be occurring based on the increased observation of daughter products (cis-1,2-DCE) associated with the reductive dechlorination of chlorinated solvents. The increase in average cis-1,2-DCE concentrations is primarily attributed to an increase in the concentration of cis-1,2-DCE in MW-41, which increased from 100 µg/L to 230 µg/L.

Table 16h - Average COC Concentrations in the Lower Shallow Aquifer System (LSAS) in 2016 and 2017			
COC	**Concentration (August 2016) (µg/L)**	**Concentration (August 2017) (µg/L)**	**Percent Change (LSAS)**
1,4-D	29.6	19.0	-35.9
TCE	95.9	86.6	-9.7
PCE	5.1	3.5	-30.2
cis-1,2-DCE	15.2	20.0	32.1
1,1-DCE	10.1	5.5	-45.9
1,1-DCA	5.8	3.8	-35.0
VC	0.1	0	-26.8

The composite COC distribution is presented in Figure 5-16 along with the estimated LSAS capture zone. The area of COC concentrations exceeding GCTLs in the LSAS identified in August 2017 was 88 acres compared to 92 acres in August 2016. Application of the *Mann-Kendall* statistical method (Mann-Kendall, 2003) to 1,4-D data at well MW-101 (see Section 4.4.2) resulted in an increasing trend for 1,4-D at that well, with a 98.1% confidence factor. Appendix K includes VOC Concentration versus Time Charts for a group of selected LSAS monitoring wells (MW-41, MW-77, MW-81, MW-86R, MW-87, MW-98, MW-101, and PZ-LSAS-4).

5.4.4.3 COC Distribution in the AF Gravels

The distributions of 1,4-D, TCE, PCE, cis-1,2-DCE, 1,1-DCE, 1,1-DCA, and VC in the monitoring wells and private wells within the in the AF Gravels are shown on Figures 5-17 through 5-23, respectively. Average concentrations for each COC using the laboratory analytical data from the August 2016 and August 2017 sampling events are summarized below in Table 16i. While average total COC concentrations generally decreased from the August 2016 sampling event, the average concentration of 1,4-D slightly increased. Observations for the AF Gravels are summarized below.

Table 16i- Average COC Concentrations in the AF Gravels in 2016 and 2017			
COC	**Concentration (August 2016) (µg/L)**	**Concentration (August 2017) (µg/L)**	**Percent Change (AF Gravels)**
1,4-D	22.7	25.4	11.7
TCE	6.8	6.0	-12.7
PCE	0.0	0.0	0.0
cis-1,2-DCE	88.1	70.1	-20.5
1,1-DCE	12.6	10.1	-19.9
1,1-DCA	3.1	3.1	0
VC	18.0	14.9	-17.5

The composite COC distribution is presented in Figure 5-24 along with the estimated AF Gravels capture zone. The area of COC concentrations exceeding GCTLs in the AF Gravels identified in August 2017 was 67 acres compared to 67 acres in August 2016. Appendix K includes VOC Concentration versus Time Charts for a group of selected AF Gravels monitoring wells (MW-127, MW-130, MW-134, MW-253, and IWI-1).

5.4.4.4 COC Distribution in the S&P Sands

The distributions of 1,4-D, TCE, PCE, cis-1,2-DCE, 1,1-DCE, 1,1-DCA, and VC in monitoring wells and private wells in the S&P Sands in August 2017 are shown on Figures 5-25 through 5-31, respectively. Average concentrations for each COC using the laboratory analytical data from the August 2016 and August 2017 sampling events are summarized below in Table 16j. Results indicated a decline in average concentrations of COC in the S&P Sands with the exception of the average concentration of 1,1-DCA which increased. Analytical data indicated that biotic or abiotic processes appear to be occurring based on the increased observation of daughter products (1,1-DCA) associated with reductive dechlorination of chlorinated solvents. Observations for the S&P Sands are summarized below.

Table 16j - Average COC Concentrations in the S&P Sands in 2016 and 2017			
COC	**Concentration (August 2016) (µg/L)**	**Concentration (August 2017) (µg/L)**	**Percent Change (S&P Sands)**
1,4-D	5.4	3.7	-32.3
TCE	2.3	1.2	-49.1
PCE	0.0	0.0	0.0
cis-1,2-DCE	3.5	1.6	-54.7
1,1-DCE	1.3	0.3	-76.8
1,1-DCA	0.4	0.5	22.4
VC	0.1	0.1	0

The composite COC distribution is presented in Figure 5-32 along with the estimated S&P Sands capture zone. The area of COC concentrations exceeding GCTLs in the S&P Sands identified in August 2017 was three acres compared to four acres in August 2016. Concentrations of COC in IWI-2 and MW-128 have historically fluctuated. Appendix K includes VOC Concentration versus Time Charts for a group of selected S&P Sands monitoring wells (IWI-2 and MW-128).

5.4.4.5 COC Distribution in the Lower AF Sands

No COC were detected at concentrations greater than GCTLs in monitoring wells screened within the Lower AF Sands, as shown on Figures 5-33 through 5-39. These results are consistent with historical data.

5.4.4.6 Temporary Point of Compliance

The comprehensive August 2017 overall GCTL boundary is presented on Figure 5-40. This overall boundary was used to define the proposed 2017 Temporary Point of Compliance (TPOC). The observations presented in Section 5.4.4 regarding changes in groundwater COC concentrations and distributions did not necessitate additional TPOC notifications, per Rule 62-780.220, F.A.C. The estimated area of the August 2017 GCTL boundary was 132 acres as compared to 140 acres for the August 2016 boundary. This change is a decrease in area of approximately 6%.

5.4.4.7 Additional Volatile Organic Compounds

In addition to the COC described above, data from laboratory analyses were reviewed to determine if concentrations of additional reported compounds from groundwater samples were detected or exceeded GCTL limits. Concentrations of additional volatile compounds were either not detected or detected below their respective GCTLs.

5.5 CONTAMINANTS OF CONCERN MASS REMOVAL

The mass of COC (PCE, TCE, cis-1,2-DCE, VC, 1,4-D, 1,1-DCA, and 1,1-DCE) removed during this one-year reporting period is estimated to be approximately 64 pounds, based on the average combined influent COC concentrations and volume of extraction for each month. The mass is calculated using the average of two (if available) groundwater combined influent sample results per month (presented in Table 8) and the monthly combined influent flow totals, which were presented in Section 5.1. The results of these calculations are shown in Table 17. Mass removal rates in 2017 averaged approximately 5.3 pounds per month compared to 7.0 pounds per month in 2016. The reduction in the mass removal rate is attributed to the overall decrease in COC concentrations due to the removal by the GRTS and natural processes.

5.6 WETLANDS MONITORING PROGRAM

The June 2017 annual wetlands monitoring event was the fourth conducted during RAPA operations. The RWs and TWs exhibited normal water level fluctuations in response to the normal seasonal rainfall distribution for the region. The Wetlands Monitoring Report was submitted to the FDEP and the SWFWMD on August 30, 2017. FDEP approved the report on September 25, 2017 and SWFWMD on September 18, 2017. The wetland telemetry system continues to operate well, eliminating the previous need for frequent wetlands visits, while also allowing quick access to water level instrumentation status to determine changes in functionality requiring attention. Data provided by the telemetry system also continues to be used for continuous GRTS optimization; specifically, for monitoring and adjusting groundwater extraction and recharge in the vicinity of TW-6, located on the northwest corner of the agricultural property east of the Facility.

5.7 WASTE MANAGEMENT

Approximately 66,000 pounds of non-hazardous dewatered filter cake solids were removed and transported to the Clark Environmental disposal facility in Mulberry, Florida during the reporting period. Solids are removed through primary settling tanks, ultra-filters, and media filter backwashing, and subsequently pumped to the solids thickening tank, settled, and then dewatered through the operation of the filter press. Transportation and disposal of the dewatered solids is contracted through Southern Waste Services, Inc. See Appendix L for waste characterization laboratory analytical results of the dewatered solids and disposal facility waste acceptance letters. See Appendix M for the dewatered solids non-hazardous waste manifests.

The GAC system primarily provides a polishing step for the removal of 1,1-DCA. The GAC becomes saturated with organic compounds and requires periodic replacement. During each GAC replacement event, approximately 10,000 pounds of non-hazardous spent carbon is removed, stored in lined and covered dumpsters, and transported to a landfill for disposal. Carbon change-out events were conducted in October 2016, March 2017, and July 2017. During these events, Adler Tank removed and transported approximately 40,000 pounds (dry weight) of spent carbon to the Waste Management landfill in Okeechobee, Florida for disposal. See Appendix L for the spent carbon waste characterization laboratory analytical results and landfill waste acceptance letters. See Appendix M for spent carbon non-hazardous waste manifests.

The filter cake material and waste GAC are disposed at Lockheed Martin-approved, permitted and licensed facilities in accordance with applicable environmental laws and regulations.

Section 6
SUMMARY

Lockheed Martin constructed and has operated the GRTS at the Site per the following orders and guidance:

- Consent Order No. 04-1328
- Consent Order No. 08-22542009 (as amended)
- 2009 RAPA
- 2012 FDEP RAPA Approval Order
- Approved OMM Manual
- Approved recommendations in previous RASRs

The reporting period for this document covers operation from September 1, 2016 through August 31, 2017. The GRTS is meeting the RAOs described in Section 1.2. The following sections provide conclusions for the reported data by OMM activity in the appropriate context for further interpretation, and also recommendations for each activity.

6.1 PROCESS PERFORMANCE AND COMPLIANCE MONITORING

Based on the data presented in this report, Lockheed Martin provides the following, conclusions and recommendations for the GRTS:

- A total of approximately 73,556,700 gallons of groundwater was successfully extracted, treated, and discharged, during this reporting period, bringing the total cumulative volume of groundwater extracted and treated since initial startup in November 2013 to approximately 299,673,200 gallons.

- The GRTS was operational 95.3% during the reporting period.

- The GRTS was successful in meeting the MCUO Discharge Permit criteria.
- The conditions of the SWFWMD WUP for extraction volumes and monthly reporting were achieved.
- The RO effluent concentrations discharged to the infiltration galleries and on-Facility injection wells met discharge criteria, defined as the lower of either the GCTL or Surface Water Quality Standards for constituents detailed in RAPA Table 10-3.
- The GRTS removed approximately 64 pounds of COC mass.
- Approximately 66,000 pounds of non-hazardous dewatered filter cake solids and 40,000 pounds of non-hazardous spent GAC were removed and transported for disposal to approved facilities.

Lockheed Martin will continue to operate the GRTS through the next operational reporting period. The operation will include the following actions:

- Meet the RAOs during the next reporting period
- Extract groundwater for treatment and discharge per the Consent Orders, the 2009 RAPA, the 2012 FDEP RAPA Approval Order, and the approved OMM Manual
- Continue scheduled compliance sampling
- Discharge to infiltration galleries as needed to maintain water levels in wetland areas
- Discharge to on-Facility injection wells to perform focused flushing of areas with highest historical COC concentrations
- Meet MCUO discharge permit and WUP requirements

6.2 GROUNDWATER LEVEL MONITORING

Based on the data presented in this report, Lockheed Martin provides the following conclusions for the groundwater level monitoring program:

- Groundwater level monitoring indicated the GRTS system continued to maintain adequate hydraulic control of the Site COC in the USAS, LSAS, AF Gravels, and S&P Sands from September 2016 to August 2017, as discussed in Section 5.3.2.
- By design, the GRTS system did not influence the Lower AF Sands.
- The LTWLM program continued to monitor the effects of the GRTS system and off-Site pumping influences and generally confirmed the description of hydraulic gradients detailed in Section 5.3.2.

Based on the data presented above, Lockheed Martin recommends continuing the current water level monitoring program as depicted on Table 18, and the LTWLM program.

6.3 EXTRACTION WELL SAMPLING

Based on the data presented in this report, Lockheed Martin provides the following summary of the extraction well sampling program:

- The GRTS system continued to extract and treat the groundwater COC plume. Generally, the COC concentrations in the groundwater extracted from the USAS, LSAS and AF Gravels are stable to decreasing, as indicated by the results discussed in Section 5.4.1.
- EW-2103 flow rates were regulated to maintain TW-6 water levels.
- Groundwater in the S&P Sands with COC concentrations in excess of GCTLs was well within the S&P capture zone; therefore EW-5002 remained off during the period of performance, with the exception of periodic operation to maintain well function.

Lockheed Martin recommends continuing semi-annual extraction well sampling aligned with the effectiveness monitoring to occur in February and August 2018. Future operation of extraction well EW-5002 will continue to be evaluated in an effort to achieve RAOs.

6.4 EFFECTIVENESS MONITORING

Based on the data presented in Section 5.4.4, Lockheed Martin provides the following conclusions for the effectiveness monitoring program:

- Analytical results indicate average COC concentrations are generally decreasing in the USAS, LSAS, AF Gravels, and S&P Sands groundwater since August 2016, indicating a reduction in in-situ COC mass. An exception to this is the slight increase in average concentrations of daughter products in the LSAS (cis-1,2-DCE) and S&P Sands (1,1-DCA). Analytical data indicate that biotic or abiotic processes appear to be occurring based on the increased observation of daughter products associated with reductive dechlorination of chlorinated solvents. These processes are aiding in the removal of contaminant mass in addition to the physical removal of contaminants associated with the GRTS.

Based on recent and historical groundwater sampling data, Lockheed Martin recommends the following for the effectiveness monitoring program:

- Continue with the semi-annual and annual sampling scheduled to occur in February 2018 and August 2018, respectively, as shown on Figure 6.1 and Table 19. Lockheed Martin does not recommend changes to the annual groundwater monitoring program at this time.

- Continue to sample LSAS monitoring well MW-101 semi-annually until a downward trend in concentration is observed with at least a 95% confidence factor, as determined using the *Mann-Kendall* statistical method (Mann-Kendall, 2003).

- Sample AF Gravels monitoring well MW-129 in February 2018 and August 2018.

6.5 BIENNIAL PERSULFATE MONITORING

Lockheed Martin provides the following conclusion for the annual persulfate monitoring program:

- Analytical results indicated that groundwater concentrations of target parameters in monitoring well MW-39 were below GCTLs for two consecutive sampling events.

Lockheed Martin recommends the following for the biennial persulfate monitoring program:

- Discontinue the sampling of MW-39 in the biennial persulfate monitoring program.

6.6 WETLANDS MONITORING

The following conclusions are from the 2017 Annual Wetlands Monitoring Report:

- Groundwater elevations at TW-6 during the 2017 monitoring event are consistent with those observed during the 2016 monitoring event, indicating that RC-7002 is successfully augmenting groundwater recharge and effectively buffering TW-6 from declines attributable to operation of the GRTS system.

- Wetland vegetation observed in the RWs and TWs during the 2017 monitoring event has remained similar to that recorded in the baseline monitoring reports.

Lockheed Martin recommends the following for the wetlands monitoring program:

- Continue to address potential GRTS system impacts to TWs by appropriately adjusting flow rates at extraction wells and through the operation of recharge galleries.

- Continue annual WMP monitoring and reporting in 2018 during GRTS operation.

- Submit a Wetlands Monitoring Report and comparative analysis with local climate and previously collected data to the SWFWMD by September 1.

- Re-evaluate the monitoring plan with the FDEP and SWFWMD after five years of system operation to determine whether it needs to continue or be modified, as described in the RAPA and the approved 2017 Wetlands Monitoring Report.

Section 7

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